

while those on the other cut both in and out. This particular property is not shown by the model as constructed, with the present choice of co-ordinates. If, however, we had measured entropy horizontally in the diagram, then the isentropics, being vertical, might be tangent to cut through the steam-line. This choice of co-ordinates has, however, seemed impossible for the reasons previously given.

We may if we wish discuss the question by a different method. The lines drawn in Figs. 1 and 2 are all lines through the critical point. In Fig. 1 the lines of constant pressure and

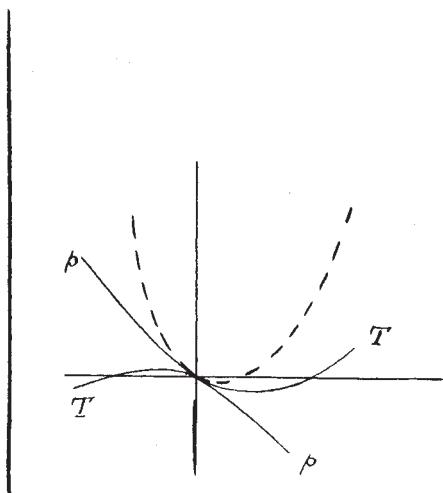


FIG. 2.

temperature are tangent to the broken line; Fig. 2 shows the same property. In Fig. 1 the line of constant entropy cuts the broken line twice, but no other pair of lines has more than one intersection. Fig. 2 does not, as drawn, show the same property. In Fig. 1, passing from the water-line around the critical point in the homogeneous region to the steam-line, one cuts the lines in the following order: water-line, pressure, temperature, entropy, volume, pressure, temperature, entropy, steam-line. Fig. 2 gives the same order, with the choice of co-ordinates, which we have adopted, if we let the temperature lines always

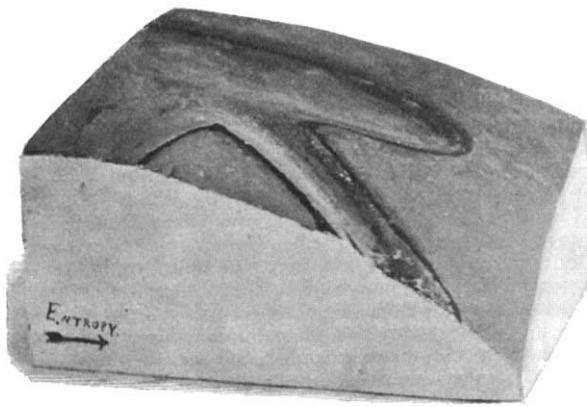


FIG. 3.

slope downward, as do the pressure lines. With this change the two diagrams seem to agree, but otherwise their disagreement seems hopeless.

I shall be very glad to receive from any one any suggestion which will help to remove the apparent disagreement between the two diagrams, or so modify the model that it may more completely represent the possible properties of actual bodies than it now seems to do.

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The University of California,
Berkeley, Cal., U.S.A., February 1.

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To Calculate a Simple Table of Logarithms.

A YEAR ago Prof. Perry drew attention to a method by which a schoolboy knowing how to extract square roots could, with the help of squared paper, construct a table of logarithms (*NATURE*, February 23, 1899).

It does not appear to be known that it is possible for a boy to make a simple table of logarithms in a few minutes without even knowing square root in arithmetic.

Up to a few years ago the teaching of logarithms in schools was generally deferred until they were required in trigonometry for the solution of triangles, but the general introduction of practical physics into secondary schools has resulted in the teaching of logarithms to younger boys.

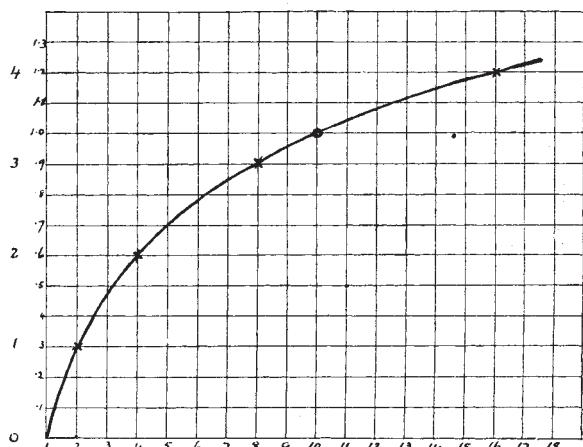
The following method which I have introduced into several Schools of Science in my district has been carefully tested in classes of boys of about thirteen years of age with excellent results.

On a sheet of squared paper ruled in inches and tenths, plot logarithms to base 2 : $\log_2 2 = 1$: $\log_2 4 = 2$: $\log_2 8 = 3$: $\log_2 16 = 4$, and draw a curve.

It will be found convenient to arrange numbers from 1 to 16 on a horizontal axis, taking 1" as unit, and the logarithms on the vertical axis, taking 3" as unit.

From the curve read off the value of $\log_{10} 10$, which will be found to be approximately $3\frac{1}{3}$. Let us assume that $\log_{10} 10$ is exactly $3\frac{1}{3}$.

On any system of logarithms $\log_4 4 = 2 \log_2 2$: $\log_8 8 = 3 \log_2 2$, &c. Hence the curve obtained may be used to represent



The left-hand vertical column of figures in the diagram represent scale logs. to base 2, and the right-hand column scale logs to base 10.

logarithms to any base if the ordinates are measured on a suitable scale.

The scale used for measuring logs. to base 2 is a plain scale. To construct a scale for measuring logs. to the base 10, write $\log_{10} 10 = 1$ instead of $3\frac{1}{3}$; and as this falls on the 10th line, the distance from 0 to 1 can be at once divided into 10 parts, and numbered $0\cdot1 : 0\cdot2$, &c., the finer lines (not shown in the diagram) giving the second decimal place.

Having assumed that $\log_{10} 10 = 3\frac{1}{3}$, $\log_{10} 2$ becomes .300 instead of .301, so that the values from the curve are in error to the extent of $1/300$; but this is not greater than small errors due to the freehand drawing of the curve and irregularities in the ruling of the squared paper.

ARTHUR DUFTON.

Sheffield, February 13.

THE publication of Mr. Dufton's method will, I think, serve a useful purpose. It is a common exercise in schools to plot on squared paper, numbers and their logarithms to the base 2 (see Blaine's "Methods of Calculating," Spon), to give a general notion of how the logarithm varies as the number varies; but I have never known it to be made a method of calculation. Indeed, I do not think it right to give a boy the idea that he may find $\log_{10} 10$ by interpolation between $\log_{10} 8$ and $\log_{10} 16$. There is a specious appearance of accuracy due to the fact that $\log_{10} 10$ is so nearly $3\frac{1}{3}$; and Mr. Dufton heightens it by using

squared paper on which the divisions are thirds of the unit, so that a boy will have it fixed in his mind that $3\frac{1}{3}$ is exactly $\log_{10} 10$.

My intention was to give a good exercise on the use of squared paper for interpolation; it happens to be a method of calculating logarithms correctly to as many places as we please. It keeps before a boy the simple notion that a common logarithm is the index of a power of 10. The idea before Mr. Dutton's pupil is much more complex, and he is not likely to find the logarithm of any number correct even to the second figure.

February 19.

JOHN PERRY.

RECENT PROGRESS IN PHOTOGRAPHY.

THE progress of knowledge and of skill in its application is often so gradual that although there may be a vast difference between the condition of affairs a few years ago and at the present time, it may be impossible to discover definite steps in the general forward movement. And after a few specific cases of undoubtedly progress have been singled out, it may be that they, or some of them, will subsequently prove to be only side issues of comparatively trivial importance. On the other hand, a circumstance that is quite obvious to the scientific student may be worked upon by a commercial firm and so advertised that a method of work becomes largely modified, and a practical advance effected without any addition to our knowledge.

It has been known from the earliest of photographic times that sensitive surfaces require a certain minimum of exposure before any change in them can be detected. But the abolition of so-called dark rooms for printing by development, and the employment of the same light for development as for exposure, was a possibility almost neglected until the American "Velox" paper was introduced. Of course, for exposure the printing-frame is held very near to the light, and during development the print is shaded. This method of work may be only a passing fashion, but it has revolutionised the printing arrangements of many an amateur, and been so appreciated that several firms have put slow papers and lantern plates on the market for working in the same manner, and other makers are seriously discussing whether it is desirable to do so.

A modification of pigment printing that has recently been introduced by Mr. Thomas Manly constitutes a more substantial advance, though whether it will be so widely appreciated as the silver papers slow enough for development in gas-light remains to be seen. He calls his process "Ozotype." So far as concerns important and serious work, a small improvement in either carbon or platinum printing is likely to be of more real value than any possible change in silver printing. But Mr. Manly's is not a mere modification of detail. Putting it simply, he exposes the transfer paper instead of the pigmented tissue under the negative, and thus by one transfer he gets a print that is not laterally inverted, a result which requires a double transfer by the ordinary method, or else the making of a special inverted negative for single transfer. As the paper exposed is not pigmented, the progress of printing can be judged of by inspection, and there are other advantages of a less important character, such as the absence of any need for "safe edges" to the negatives. The paper that is exposed under the negative is made sensitive by means of a mixture of potassium dichromate and a manganous salt. On exposure, the chromate is reduced and the manganese is thereby oxidised, and both products of the change are insoluble in water. By washing, an image that has oxidising powers is obtained, and this may be utilised in many ways. It does not seem to deteriorate by keeping. To pigment the image, a piece of carbon tissue is soaked in a weak solution containing acetic acid, hydroquinone, and ferrous sulphate, squeegeed

on to the print and allowed to dry. Development is effected as usual in carbon printing. Mr. Manly supposes that the acetic acid causes the manganic compound to reoxidise the chromic compound to a soluble salt (chromate?) which is absorbed by the gelatine of the tissue. In the gelatine the hydroquinone reduces the chromium compound to the chromic condition, which, as usual, renders the gelatine insoluble. This appears to be the inventor's working theory. Final practical details are not yet published, but it is certain that the process is capable of yielding good and useful results.

The toning of prints in which the image consists of metallic silver by causing it to act on the solution of the ferricyanide of a metal, reducing it, and thereby causing the deposition of the corresponding ferrocyanide on the image, is a method that has long been known. The ferrocyanide of copper, being of a reddish-brown colour, is a desirable toning material, but copper ferricyanide is not soluble in water, and the various solvents hitherto employed have not given satisfaction. Mr. W. B. Ferguson has just shown that a solution of potassium citrate is a solvent for the ferricyanide that serves perfectly, and has thus converted an almost useless process into one that is easy and certain. The colour appears to be rather browner than that yielded by the corresponding uranium process, and it is hoped that the colouring matter will prove more permanent.

There have recently been quite a number of new introductions that affect the production of negatives. Foremost among these stand the rapid "spectrum plates" of Cadett and Neall, and the colour screens adjusted thereto by Mr. Sanger Shepherd. Red sensitive plates have been made before, but the even sensitiveness throughout the spectrum that these plates show, has never, in our experience, been equalled. But no plate will of itself render the various colours according to their proportional visual brightness. The sensitiveness to blue and violet vastly preponderates in all cases, and in order to reduce this light and so compensate for the excessive sensitiveness thereto, various coloured screens have been in use. For general purposes, this screening has been done by the roughest of methods, whether yellow glass or dyed films have been used. But Mr. Sanger Shepherd has prepared screens that are adjusted to the plates within a small margin of error, using for the testing the method of colour sensitometry introduced by Sir William Abney. With such an adjusted colour screen and plate a coloured object can be photographed in almost any light so that the print will give the correct comparative luminosities of all the colours as they appear under the conditions when photographed. The chief exception is that light of less refrangibility than the solar line C, or about that, is not represented, this small portion of the less refrangible red being reserved as a light useful when making the plates and working with them. Colour screens are provided for dark-room lights, that transmit only the least refrangible red, far enough from where the practical sensitiveness of the plates begin to furnish a light that is quite unable to harm the plates under the usual conditions of development, &c. Mr. Sanger Shepherd also prepares colour screens for spectrum plates adapted for the three-colour process of reproduction, and as they are adjusted by measurement and to the same plate, this is a considerable step towards the simplification of work and the ensuring of correct results.

Some new intensifiers for negatives have recently been suggested, but as their effects have not been thoroughly investigated, they should not replace the use of mercuric chloride followed by ferrous oxalate, which is the only method that has yet been shown to give a definite result equally proportioned over the whole negative. Ammonium persulphate, as a reducer, has been shown to thin the image to a nearly equally proportioned degree all